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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COMMITTEE OF ONE HUNDRED

FUNDS FOR RESEARCH IN ASTRONOMY

WHEN drawing up the report upon Research Funds made to the American Association in December, 1915, and subsequently printed in SCIENCE there seemed to the committee to be good reason for believing that it would be advisable to place the data relative to astronomical observatories in a separate article, together with certain additional facts which would be of value to those particularly interested in astronomical research.

For this reason a circular letter of inquiry, dated February 1, 1917, was sent to the principal American observatories asking a reply to the following questions in each case:

1. What are the principal and annual interest of observatory funds available for research as distinguished from teaching and what fraction of the income as far as can be estimated may be credited to research?

2. What are the stated publications of the observatory or other papers indicating the results of researches accomplished?

The replies to this letter are uniformly clear and full. Abstracts of them are given below with data taken in some cases from official publications. It is thought that this form of presentation is preferable to a mere tabulation inasmuch as a more definite idea may thereby be secured as to the conditions which obtain in each of the observatories concerned. Especially does this seem desirable in that those interested in astronomy though not professionally engaged in its pursuit may find a brief but intelligible statement of what provision has been made in this country up to the present for the actual advancement of the science by research.

The undersigned will be glad to receive cor-

rections of any omissions or errors in statement.

Dudley Observatory, Albany, N. Y. Benjamin Boss, Director.

1. Principal of Observatory Funds, $140,000. Interest $6,300, wholly devoted to research, including miscellaneous running expenses.

Appropriation received from the Carnegie Institution (department of meridian astrometry); $29,656 annually is entirely devoted to research, with the exception of $1,500 appropriated for miscellaneous purposes.

2. The researches of the observatory are largely printed in the Astronomical Journal which is published by the observatory, and which is, moreover, a general organ for astronomy in the United States. Researches have also been published separately by the observatory and by the Carnegie Institution, not in serial form.

Amherst College Observatory, Amherst, Mass. David Todd, Director.

1. No funds available for research are possessed by the observatory.

Ten astronomical expeditions have, however, been undertaken by it, eight for total solar eclipse observations. The funds requisite for these were supplied from various sources, among which were the National Academy of Sciences, the United States government and the Alumni of Amherst College.

2. The observatory has no funds available for publication.

The results of the researches referred to above have been published by the Smithsonian Institution and in the Astronomical Journal, the Monthly Notices of the Royal Astronomical Society and the Astrophysical Journal.

Detroit Observatory, University of Michigan, Ann Arbor, Michigan. Wm. Joseph Hussey, Director.

1. Supported by annual appropriations made through board of regents of the university, with occasional gifts from interested friends of the observatory.

2. Investigations are printed in The Publications of the Observatory. Two volumes have been issued thus far.

Students' Observatory, University of California, Berkeley, Calif. Armin O. Leuschner, Director.

1. No endowment devoted exclusively to astronomical research. This is maintained so far as pecuniary aid is concerned by funds available from annual budget of laboratories (about $300 for equipment) and private gifts. About one quarter of the time of members of the staff is available for research. Special grants from university funds are made to individuals on recommendation of a research board. Great aid has been given from the Watson Fund of the National Academy of Sciences.

2. Results of researches are published in Publications and Bulletins of Lick Observatory, and in Memoirs of the National Academy.

The principal need of the observatory, the researches in which are theoretical, is that of trained research assistants and computers, which is now met to some extent by graduate students. "There is a crying need for income from regular endowment. Library facilities are amply available. Many important problems in theoretical astronomy and celestial mechanics can not be tackled until endowed research assistantships are available. The country needs a bureau for theoretical research, for numerical investigation of problems of motion, solar and stellar systems, including in the latter binaries, visual, spectroscopic, variable, etc. This important branch of astronomical science is sadly neglected. It should be kept apace with the work of the great observatories."

Harvard College Observatory, Cambridge, Mass. Edward C. Pickering, Director.

1. Principal of funds, July 1, 1915, $860,659.03. Income for preceding year, $53,808.15. Entire income is devoted to research.

2. Publications:

Annals, quarto, of about two hundred fifty pages each; seventy-seven volumes are complete, six in process of publication.

Circulars, quarto, one to four pages, two hundred issued.

Bulletins, octavo, one page, six hundred twenty-four issued.

Annual Report, octavo, ten to fifteen pages, last issued the seventieth.

Several Reports of the Visiting Committee and numerous miscellaneous pamphlets, generally octavo.

Students' Astronomical Laboratory, Harvard University, Cambridge, Mass. Robert W. Willson, Professor of Astronomy.

1. Is primarily intended for teaching the science to undergraduate and graduate students. A certain amount of research is carried on, but no stated appropriation therefor is made.

Leander McCormick Observatory, University of Virginia, University, Charlottesville, Va. Samuel Alfred Mitchell, Director.

1. No permanent research fund. There are at present available for research and thus used the "Special Adams Fellowship" from Columbia University for five years, giving $1,000 per year, devoted to determination of stellar parallax by photography; and temporary grants from the Smith Fund of the National Academy of Sciences, for meteor research, that for the present year being $300.

2. The Publications of the Leander McCormick Observatory now in its second volume.

University Observatory, University of Cincinnati, Cincinnati, Ohio. Jermain G. Porter, Director.

1. No definite provision made for research.

Laws Observatory, University of Missouri, Columbia, Mo. Robert H. Baker, Director.

1. No definite income specially devoted to research. A certain amount is available for appropriations for laboratory purposes in connection with teaching.

2. Publications: Laws Observatory Bulletin, printed at expense of university. Twenty-eight numbers issued thus far and three additional are in press (February 26, 1917). These are paid for out of the general printing fund of the university.

The observatory has under way the investigation of a list of eclipsing variable stars by the extra-focal photographic method. The photographic results already accumulated are far in advance of measurements and computations, so that there is great need of funds for securing suitable assistance for these purposes.

Emerson McMillin Observatory, Ohio State University, Columbus, Ohio. Henry C. Lord, Director.

1. No funds available for research as distinguished from teaching.

2. No stated publications.

Dearborn Observatory, Northwestern University, Evanston, Ill. Philip Fox, Director.

1. Research Fund of $1,500; a gift from the Chicago Astronomical Society.

Maintenance of observatory and salaries met by the university. Annual appropriation for equipment of $500. It is estimated that about half of salary appropriations, amounting at present to $4,975, may be credited to research.

2. Earlier researches have been published in various astronomical periodicals, which will continue to be the case to a certain extent.

One volume of Annals of the Dearborn Observatory published thus far, and it is expected to issue others later.

Lowell Observatory, Flagstaff, Arizona. Guy Lowell, Trustee.

1. Constitution of astronomical staff and amount of funds available for research are not at present determined pending the settlement of the estate of the late Professor Percival Lowell.

2. Publications:

Lowell Observatory Annals.

Lowell Observatory Bulletins.

Lowell Observatory Memoirs.

Lowell Observatory Observation Circulars.

Results of observations are frequently published in astronomical journals.

Shattuck Observatory, Dartmouth College, Hanover, N. H. John M. Poor, Director.

1. Aside from salary of director for teaching paid by trustees of the college, there are available annually $100 from "Library" Fund and $400 income from permanent fund of $10,000 for instrumental and library equipment. The college has at times paid a graduate student for part-time service as a computer. "The one thing needed here is assistance to do computing and routine work," the lack of which holds back greatly the progress of research which otherwise might be carried out.

2. The observatory has no stated publications. Papers from it have been printed in the Astrophysical Journal and Astronomische Nachrichten.

Cornell University Observatory, Cornell University, Ithaca, N. Y. Eugene E. Haskell, Dean of College of Civil Engineering.

1. The new observatory is but recently completed. There is no endowment for research. The work at present is almost wholly instruction.

Washburn Observatory, University of Wisconsin, Madison, Wis. George C. Comstock, Director.

1. No specific fund available for research.

2. Publications of the Washburn Observatory. Twelve volumes issued.

Van Vleck Observatory, Wesleyan University, Middletown, Conn. Frederick Slocum, Director.

1. No special research fund as yet provided, as it is only a short time since the new observatory was finished.

2. Results of the researches of the director have been published in various astronomical and astrophysical journals.

Lick Observatory, University of California, Mount Hamilton, California. William W. Campbell, Director.

1. Devoted exclusively to research. There is no formal teaching. Several graduate fellowships are

maintained by the university, the holders of which, usually for three years, are in training for professional astronomers. In the last year of their fellowship they habitually devote their whole time to their own investigations as a basis for their Ph.D. thesis. There is also available for a like purpose the Martin Kellogg Fellowship, income $1,200 per annum, the holder of which must have received the degree of Ph.D. or its equivalent.

The observatory is mainly supported by an annual appropriation from the regents of the university of approximately $33,000.

The D. O. Mills Expedition to the Southern Hemisphere, a temporary branch of the Lick Observatory, is maintained by direct personal gifts from friends of astronomy amounting to about $7,000 per year.

2. The researches of the Lick Observatory are printed in the following:

Publications, Vols. I.–XII., 4to, 1887–1914.
Bulletins, Vols. I.–IX., 4to, 1901–1917.
Contributions, 8vo, Nos. 1–5, 1889–1895 (now discontinued).
Moon Atlas, 1897.

Maria Mitchell Observatory, Nantucket, Mass. Margaret Harwood, Director.

1. Principal of Observatory Funds, $38,100; annual interest $1,730 approximately. Nine tenths of the income may be credited to research.

2. Results of researches are published by the Harvard College Observatory in its Annals.

Winchester Observatory, Yale University, New Haven, Conn. Mason F. Smith in charge.

1. No teaching is done at the observatory. The total funds, $450,000, are applicable to research and maintenance but are at present subject to large annuity charges. Income for 1916 was $13,000.

2. Researches are printed from observatory funds as memoirs.

Columbia University Observatory, New York, N. Y. Harold Jacoby, Professor of Astronomy.

1. Participates in research funds of the university.

Smith College Observatory, Smith College, Northampton, Mass. Harriet W. Bigelow, Professor of Astronomy.

1. No endowment for research. "Computing Fund" of $100 annually is used for assistance in preparing observations of the observatory for publication. Work is limited closely to teaching.

2. "Comet Observations" from the observatory have appeared in the Astronomische Nachrichten and the Astronomical Journal, in about fifteen numbers.

Goodsell Observatory, Carleton College, Northfield, Minn. Herbert C. Wilson, Director.

1. No funds specifically devoted to research.

For several years past the college has made appropriations of small amounts for this purpose. Aid ($650) has also been received during the past two years from the Watson Fund of the National Academy of Sciences, to assist the work of the director in determining the photographic positions of asteroids.

2. Five numbers of Publications of the Goodsell Observatory have been issued, 1890–1917, the cost of which has been defrayed mostly by private subscription, and in part from the earnings of the magazine Popular Astronomy. The college will publish future researches if not too costly.

Wheaton College Observatory, Wheaton College, Norton, Mass. Laura M. Lundin, Assistant Professor of Mathematics, in charge.

1. At present devoted wholly to purposes of instruction.

Dominion Astronomical Observatory, Ottawa, Canada. Otto Klotz, Director.

1. Work of observatory is wholly research and is supported by direct vote of public money.

2. Publications of the Dominion Astronomical Observatory issued from time to time.

Mount Wilson Solar Observatory, Pasadena, California. George E. Hale, Director.

1. Appropriation from Carnegie Institution for 1917, $178,294, entirely devoted to research.

The appropriation stated above includes salaries, current expenses and provision for considerable additions to buildings and equipment, including completion of 100-inch telescope.

2. Publications:

1. Short Communications, which appear from time to time in the Proceedings of the National Academy of Sciences.
2. Longer Contributions, most of which appear in the Astrophysical Journal. Six volumes of Contributions have already been published.
3. Publications in quarto form, issued by the Carnegie Institution of Washington, containing the details of extensive investigations. Few publications of this character have yet been issued.

Flower Astronomical Observatory, University of Pennsylvania, Philadelphia, Pa. Eric Doolittle, Director.

1. No funds especially assigned to research as distinct from teaching, though a large part of the labor of the director and his assistant is devoted to research.

2. Publications of the Flower Astronomical Observatory.

Three complete volumes, each consisting of three parts, have been issued, and also Part 1 of a fourth volume.

Various papers by members of the staff are published in astronomical journals.

Allegheny Observatory, University of Pittsburgh, Pittsburgh, Pa. Frank Schlesinger, Director.

1. The institution is wholly devoted to research. Annual income at present is $13,500.

2. Publications of the Allegheny Observatory contain most of its researches. Occasional papers published in Astrophysical Journal, Astronomical Journal, etc.

Vassar College Observatory, Poughkeepsie, N. Y. Caroline E. Furness, Director.

1. Research fund, $2,000, yielding about $100 per annum, and not available for academic work or apparatus for students.

2. Publications of Vassar College Observatory. Three volumes have thus far appeared.

Princeton University Observatory, Princeton, N. J. Henry Norris Russell, Director.

1. Total funds appropriated as follows:

Thaw Fellowship, principal $10,000, annual income $500.

Annual gift for research of $1,000 from Mr. A. D. Russell promised until 1919.

Half of annual budget of department from university, which may be credited to research, a minimum estimate, $3,200.

Total, $4,700 per annum.

2. Contributions from the Princeton University Observatory. Four numbers thus far published—300 quarto pages—dealing with variable stars.

Articles published in Astrophysical Journal, Astronomical Journal, Monthly Notices R. A. S. and other journals.

The material published by the Observatory during the past five years amounts to very nearly 500 pages, dealing with variable stars, especially eclipsing variables, stellar statistics and evolution, planetary albedo and various other subjects.

Ladd Observatory, Brown University, Providence, R. I. Roland G. D. Richardson, Acting Director.

1. Is devoted to teaching only.

Blue Hill Observatory, Harvard University, Readville, Mass. Alexander McAdie, Director.

1. Devoted wholly to research. Research fund of $50,000, yielding income of $2,300 annually, applicable to maintenance of observatory and research.

2. Results of investigations published in the Annals of Harvard College Observatory.

Sayre Observatory, Lehigh University, South Bethlehem, Pa. Charles L. Thornburg, Professor of Mathematics and Astronomy.

1. None.

2. No stated organ of publication for occasional papers.

John Payson Williston Observatory, Mount Holyoke College, South Hadley, Mass. Anne S. Young, Director.

1. No permanent funds available for research.

2. Work accomplished, a portion of which has been in cooperation with workers in some other observatory, has been published in various places.

Sproul Observatory, Swarthmore College, Swarthmore, Pa. John A. Miller, Director.

1. No permanent research funds.

The work of the observatory is chiefly carried on by teachers of the college and is sustained by appropriations from the college and outside sources.

2. Publications of Sproul Observatory. Four numbers issued, chiefly devoted to stellar parallax.

Department of Astronomy, University of Arizona, Tucson, Arizona. Andrew E. Douglass, Professor of Physics and Astronomy.

1. Department of astronomy is in process of organization.

The university possesses a fund of $10,000, the income of which is available for the purchase of instruments of precision.

A certain amount of astronomical research is in progress.

University of Illinois Observatory, Urbana, Ill. Joel Stebbins, Director.

1. Observatory is supported entirely by current appropriations from university.

Of these $3,000 per annum, including proportion of salaries and expenses, may properly be charged to research.

2. Scientific results published principally in Astrophysical Journal.

Dominion Astrophysical Observatory, Victoria, B. C. J. S. Plaskett, Director.

1. This observatory is devoted entirely to re-

search and no teaching is engaged in. It is supported by the Dominion Government, but as it is only very recently established, and is neither fully equipped nor staffed, its income is not yet fixed. The sum of $7,500 was granted for maintenance and additional equipment, and from this the salaries of secretary and engineer have to be paid. Salaries of the scientific staff are provided from a separate vote, so that the total income for the current fiscal year may be put at $13,000.

2. The work of the observatory will be issued in the form of separate publications as completed. These will probably be printed at the Government Printing Bureau, and their cost will be charged against the maintenance appropriation.

U. S. Naval Observatory, Washington, D. C. Admiral Thomas B. Howard, U. S. N., Superindent.

1. Work of the observatory is entirely provided for by appropriations made by Congress. This covers observational data for and preparation of astronomical tables and other material and publication of the American Ephemeris and Nautical Almanac, provision of a longitude station, distribution of correct time, the care of all navigation instruments for navy, coast guard and lighthouse service. Also, for 1918 the cost of special eclipse expedition.

2. Publications of the U. S. Naval Observatory. Second Series, Vol. IX., now in press. Earlier papers, 1845 to 1891, published in a series of volumes, mostly annual.

Nautical Almanac Office publishes annually the American Ephemeris and Nautical Almanac and the American Nautical Almanac and Astronomical Papers of the American Ephemeris, irregularly. Also an Annual Report.

An Annual Report of the Naval Observatory is also published.

Astrophysical Observatory, Smithsonian Institution, Washington, D. C. Charles G. Abbot, Director.

1. The entire income of about $13,000 per annum is appropriated by annual acts of Congress, and is devoted wholly to research.

Publications comprise:

2. Annual Reports of the Director to the Secretary of the Smithsonian Institution printed in Smithsonian Report.

Occasional papers by members of the staff generally printed in Smithsonian Institution Miscellaneous Collections.

Annals, published by Act of Congress from time to time and printed by the Government Printing Office. Three quarto volumes have thus far appeared in 1900, 1908, 1913.

Whitin Observatory, Wellesley College, Wellesley, Mass. John C. Duncan, Director.

1. No fund for research as distinct from teaching.

2. Papers by members of the staff published chiefly in Astrophysical Journal and Popular Astronomy.

Yerkes Observatory, University of Chicago, Williams Bay, Wis. Edwin B. Frost, Director.

1. Income ($34,000) applied principally to research but in part to teaching. Four fifths, as nearly as can be estimated, of the total income is expended in research.

2. Publications:

Publications of the Yerkes Observatory, quarto. Vols. I. and II. have appeared; Vol. IV., Part 1, is in type and will soon be issued. Parts 1 and 2 of Vol. III. will be sent out at the same time, without further waiting for the completion of the volume.

The Astrophysical Journal, of which the director is managing editor, is employed as the medium of publication of the more important astrophysical work. Astrometric and other observational work, classified under astronomy of position, is published chiefly in the Astronomical Journal, although some communications are sent to the Monthly Notices of the Royal Astronomical Society. Communications of a more popular interest are frequently sent to Popular Astronomy.

The Student's Observatory of the University of Chicago is organized as a part of the general department of astronomy and has no separate appropriations.

Hopkins Observatory, Field Memorial Observatory, Williams College, Williamstown, Mass. Willis I. Milham, Director.

1. No definite provision made for research.

It will be observed from the data obtained that contrary to the impression which is generally prevalent among the public the funds which are directly and statedly available for astronomical research are far from being large. Very few of the observatories are adequately endowed and most of them rely for their maintenance upon regular grants from the universities with which they are connected. While in the case of the greater institutions reasonable support is thus virtually guaranteed, with

the smaller ones there is often much difficulty in securing the funds which are essential to efficient work. A considerable initial equipment may fail to give the results that might be expected because of inability to procure auxiliary apparatus, to secure suitable assistance in making or reducing observations, or to pay necessary expenses of publication.

Furthermore, attention should be called to an important fact which is referred to in some of the more detailed answers to the questions of the circular and which has been emphasized in earlier considerations of the subject of aid for astronomical research made by the chairman of the Committee of One Hundred.

The help most needed in a large majority of cases is found to be that of a trained assistant to aid in any and all the duties which are called for from an astronomer and especially in computing and other routine work. For such purpose a person not subject to the distractions affecting the ordinary graduate student is desirable. To furnish an observatory with well-equipped aid of this character would often increase its output by an amount far in excess of the necessary outlay.

CHARLES R. CROSS, *Chairman,*
Subcommittee on Research Funds

GEOLOGICAL TERMS IN GEOGRAPHICAL DESCRIPTIONS

LAST January Dr. John L. Rich, of the University of Illinois—now Captain in the Intelligence Division of the War Department—sent a letter to SCIENCE expressing his regret that no mention of geological dates was made in a geographical article on the "Block Mountains of New Zealand," by Dr. C. A. Cotton, of Victoria College, Wellington. I have been waiting to see if other geologists would support Captain Rich's view, or if any geographers would take sides with Dr. Cotton; but the discussion has not been continued. As Dr. Cotton was more or less influenced in his method of presentation by several conferences that we had on this subject during an excursion with Professor James Park, of Dunedin, across the New Zealand block-mountain district in 1914, I wish to say a few words on the principles that his method of presentation involves.

The first point to bear in mind is that geological science is much more actively cultivated by trained experts, and is therefore much further developed than geographical science. The second point is that the development of geographical science will be best promoted if geographers follow a discipline of their own, by giving the same single-minded attention to geography that physicists give to physics, astronomers to astronomy, philologists to philology, and so on. The third point is that the best methods of preparing geographical descriptions are still in discussion, and hence experiment on various methods, each one consciously analyzed and intentionally adopted for the time being, is a helpful means of discovering the kind of treatment best adapted for various needs.

Cotton's article is an admirable experiment in the analytic, systematic and regional treatment of a geographical problem. It is to be hoped we may have many more pure geographical cultures of this kind. The gain that such articles contribute to the imperfectly developed science of geography fully compensates, in my opinion, for any loss that the omission of geological dates entails upon the thriving science of geology. Cotton's success must therefore not be measured by the dissatisfaction that his article may create among geologists, but by the satisfaction that it creates among geographers. They should recognize that this excellent study gives, after a careful historical review of the problem under discussion, a critical analysis of the origin of the Block Mountains; that the results of the analysis are systematized or standardized sufficiently for New Zealand needs; that the systematized standards are effectively used in the final pages on regional description; and that the graphic illustration of all its parts is exceptionally good. The only adverse comment that I am disposed to make is that the unlikenesses of the three phases of work, analytic, systematic and regional, are hardly enough emphasized to impress them upon the reader; and that the introduction of some

local examples in the systematic pages and of some explanatory discussion in the regional pages results in blending the two styles of treatment undesirably. I venture to make the further suggestion that a one-page regional summary at the end of the article would have made its results more readily available to geographers in general, and would have at the same time serve as a disciplinary test of the success of all the preceding pages; for geographically speaking, it is in order to prepare such a concise explanatory description of existing forms that the analytical study of their origin and the systematization of the results of analysis are attempted.

The protests that I have made on various occasions, when urging that geographers should develop a scientific discipline of their own, have not been primarily directed against the inclusion of geological terms and items, as such, in a geographical article, for if a geographer wishes to introduce such extraneous matters, not for the benefit of the other geographers whom he is addressing, but for the satisfaction of such geologists as may honor him by their attention, he is surely free to do so although it is difficult to see how he is thereby cultivating or developing geographical science. My protests have been chiefly directed against the use of geological terms in geographical descriptions, where geographical terms are more serviceable.

For example, a recent geographical lecture on northeastern France, published in the *Scottish Geographical Magazine*, described the "escarpments," which dominate the relief of the region between Paris and the Vosges, by the time-names of the geological formations which maintain them. Surely a directly geographical statement of the composition, thickness and attitude of the cuesta-making series of strata would have been more helpful, for it is geographically immaterial when the strata were deposited: but although the lecturer is primarily a geographer, a geological terminology was employed. It is further significant of the immature condition of geography that this well-informed lecturer, addressing a geographical audience in Great Britain on the geography of the neighboring country of France, found it advisable to introduce an elementary explanation of physiographic features so simple as cuestas, as if they were unknown both in kind and in place, and yet did not feel it necessary to give explanatory definitions of technical geological terms such as Triassic and Jurassic! If a geographical audience is not familiar with the physiographic features that are ordinarily associated with a gently dipping series of harder and softer stratified formation, let them be explained by all means; but let the explanation be in pertinent geographical terms, and not in terms so irrelevant as the geological dates when the formations were laid down.

Several years ago the *London Geographical Journal* published an account of a district in central England in an article which purported to be geographical—otherwise it could hardly have found a place in that journal—and which apparently aimed to represent modern methods in scientific geography, but which must certainly have worked to the disadvantage of true geographical discipline; for its introductory pages abounded in remotely irrelevant geological speculations presented in technical geological parlance, and some of its later pages were occupied with painstaking enumerations of plant species, doubtless botanically correct, but not helpful geographically because they did not enable the reader, even if he were as expert a botanist as the writer, to make a correct mental picture of the plant assemblages by which the land forms are covered. The direct description of the landscape, the prime responsibility of a geographical essay, was much less thorough than the geological speculations or the botanical enumerations. Many a British geographer of the old school must have been confirmed, on reading this article, in his disinclination to exchange the empirical method of geographical description, with which he had been familiar from boyhood for the more modern explanatory method; for he would have exclaimed: "If these pages, with their irrelevant geological hypotheses and their detailed lists of botanical species illustrate the modern ex-

planatory method of geographical description, I want none of it!"

It is not only geological terms, but geological habits of thought, that should be avoided in geographical descriptions. For example, an account of a district in northern Africa, published in *La Géographie,* the journal of the Geographical Society of Paris, six or more years ago, included the statement that a certain locality is traversed by a fault, which brings two unlike geological formations together; but nothing was said as to the physiographic expression of the faulted structure. The reason for this silence was, plainly enough, that the author was a geologist who did not distinguish between the geological and the physiographic treatment of faults; he was interested in internal structure, as a geologist must be but he did not extend his interest, as a geographer should, to the point of showing how internal structure, acted upon by exterior forces for a shorter or longer period of time, influence surface form.

Many more examples of the geological habit of thought dominating geographical descriptions are to be found in the employment of the past tense of verbs in the treatment of existing physiographic features. The past tense is eminently fitting in those excellent summaries of physiographic development that are presented in the Geologic Folios of the U. S. Geological Survey, for these summaries are properly enough nothing more than the historic geology of land forms, in which the past tense is fitting. But when physiographic features are presented in geographical descriptions, their treatment should be so devised as to leave the reader vividly impressed with actual land forms as they exist to-day; and nothing is so helpful to this end as the use of verbs in the present tense. In the analytical treatment of physiographic problems, the use of the past tense is unavoidable; and it is for this very reason that analysis should be followed by description, if the best geographical flavor is to be given. It is well enough to say, in the course of analytical investigation, that "the Rahway River was not captured by the Passaic until it had cut a passage across the trap sheets"; but if nothing more is said the reader of such a passage will likely enough be left in the contemplation of the speculative past instead of being brought to realize the actual present.

There is some discussion at present in progress regarding "emergency problems" in education. Geography will, it is to be hoped, have a proper share of consideration. One of its emergency needs to-day is single-minded devotion to its development on the part of its devotees. If there be such a science as geography, let those who pursue it beware of the danger of falling into geological habits of thought on the one side, and into historical habits of thought on the other; let them bring into geography every relevant geological and historical item as freely as geographical items have been carried into geology and history; but let them at the same time conceive and phrase all the items and ideas that are pertinent to their subject in such a way as to give every item and idea a truly geographical flavor, and let them avoid the meretricious method of adding to their geographical articles matter that really belongs elsewhere in the hope of making them more "interesting." If geography can not stand on its own merits, let it fall.

The merit of Cotton's study is, to my reading, that he has striven with praiseworthy single-mindedness to give his subject a purely geographical treatment; his article is therefore a valuable contribution to geographical discipline. He sufficiently indicated the physiographic date of the faulting by which his Block mountains were formed by stating the stage of post-faulting dissection that they now exhibit. He might easily have added geological formation dates for the edification of geologists, petrographical terms for the pleasure of petrographers, and lists of fossils for the benefit of paleontologists, for he is a competent student in all these subjects. He consciously sacrificed these unessential elements in his successful effort to make a contribution to geography alone, as a conscious experiment

in the development of geographical science; and geography profited thereby.

W. M. Davis

Cambridge, Mass.,
June, 1918

ARMAND THEVENIN

The French paleontologist, Armand Thevenin, who lost his life on March 7, at the age of forty-eight years, as a result of experimenting with poisonous gases in connection with the war, will be remembered chiefly for his beautiful memoir on the early vertebrates of France. He was particularly interested during several years in the Coal Measures Amphibia of France and in 1906 under the title "Amphibiens et Reptile du Terrain Houiller de France" he published in the *Annales de Paléontologie* his initial memoir on this subject. In this memoir Thevenin showed a wide acquaintance with the subject of fossil Amphibia and was especially fortunate in the discovery of an interesting and primitive reptile which he described under the name of *Sauravus costei*. This form, as the most ancient reptile of France, is paralleled in America by the form *Eosauravus copei* described by Williston from the Coal Measures of Linton, Ohio.

Four years later appeared Thevenin's monographic contribution to vertebrate paleontology, published with the title "Les plus anciens Quadrupédes de France" in Tome V. of the *Annales de Paléontologie*. This beautifully illustrated and carefully written memoir was awarded a prize by the Academy of Sciences and will now stand for all time as an indication of the ability and ideals of Armand Thevenin. Had his life been spared he doubtless would have given us other memoirs of a like nature, for shortly before the war he was interested in the study of the vertebrate paleontology of Madagascar, of which several studies had appeared in the pages of the *Annales de Paléontologie*. Thevenin summarized the results of his studies on the most ancient vertebrates of France by noting, for both amphibians and reptiles, the diversity of form and structure exhibited by the species which he had studied, suggesting that the vertebrates of the Coal Measures, though very ancient, were still a long way from their origin. A similar conclusion has been reached by students of early vertebrates in America.

Thevenin was fortunate in his association in the Museum National d'Histoire Naturelle with paleontologists of international fame, such as Albert Gaudry and Marcellin Boule and he profited by his association in producing under the stimulus of their influence his interesting studies on fossil vertebrates. His list of papers is not extensive, probably not over a dozen all told, but his work was carefully and well done and he will stand as a worthy worker in the development of vertebrate paleontology. Students of paleontology in the future may gain much by studying carefully the neat and orderly presentation of facts and the beautiful illustrations of his "Les plus anciens Quadrupédes de France" and thus be stimulated to produce better and more carefully wrought pieces of thoughtful endeavor.

Roy L. Moodie

College of Medicine,
University of Illinois

SCIENTIFIC EVENTS

THE KATMAI EXPEDITION OF THE NATIONAL GEOGRAPHICAL SOCIETY

Word has just been received of the safe arrival in the field of this year's National Geographic Society expedition to the Valley of Ten Thousand Smokes. On account of the war and particularly because of the difficulty of securing transportation for a larger party it was deemed advisable to send only two men into the field this year, the director, Dr. Robert F. Griggs, and other members of the expedition remaining behind to work up the unpublished results of the expedition of 1917. The field party consists of Jasper Sayre and Paul R. Hagelbarger, both members of last year's expedition. Their mission is to carry forward reconnaissances into country not reached by previous expeditions and to lay the foundation for more intensive scientific study of the volcanic phenomena manifested in the Valley of

Ten Thousand Smokes, which it is expected to continue after the war.

The party this year entered the region from the Bering Sea side of the Alaska peninsula rather than from the Pacific as heretofore. The ship that carried them, the *Dora,* was one of those caught by the unusually bad ice conditions this spring in Bering Sea and for two days was seriously hampered by the ice floes, which made navigation precarious, but, although warned by the coast guard cutter to turn back, she finally made her way through the ice without mishap. When last heard from on June 10, the expedition was camped at the foot of Naknek Lake prepared to plunge into the wilderness.

THE BROOKLYN BOTANIC GARDEN

ON June 13 the treasurer of the Brooklyn Institute of Arts and Sciences received from two anonymous donors a gift of securities of the par value of ten thousand dollars, as an addition to the permanent endowment of the Brooklyn Botanic Garden, and to be known as the Benjamin Stuart Gager Memorial Fund. At the request of the donors, the income from this fund is to be expended for publications for the library or otherwise as the present director of the garden may designate.

The chairman of the Brooklyn Botanic Garden Governing Committee, Mr. Alfred T. White, has made provision for several prizes for 1918 and annually thereafter. The most important of these prizes is a scholarship of the value of $100 to be awarded to the boy or girl who has taken class work at the Brooklyn Botanic Garden for not less than three years, and who has shown marked ability along botanical and agricultural lines, both at the Garden and in his high-school courses, as attested by his principal and teachers. This will be known as the Alfred T. White Scholarship, and will be awarded for the first time in 1920. Further information may be obtained by addressing the director of the Garden.

Details as to this and some of the other prizes are published in the Brooklyn Botanic Garden *Leaflet* of June 20, 1918. Special mention, however, should here be made of the offer of two first and two second prizes (one for boys and the other for girls) of War Savings Stamps to the value of $15 and $10, respectively, for excellence in back-yard gardens; and of two other prizes (one for boys and one for girls) of $10 each, in War Savings Stamps, for making the best use of a plot of ground in the children's gardens at the Brooklyn Botanic Garden.

In addition to the above, twenty prizes of ten Thrift Stamps each (ten to boys and ten to girls) will be awarded to those who are most generally helpful in connection with the children's garden at the Botanic Garden. Promptness, regularity of attendance, effort, accomplishment and other points will form the basis of this award. The War Savings Stamps and Thrift Stamps will be awarded only for the period of the present war.

THE CHEMICAL WARFARE SERVICE

THE following statement is authorized by the Secretary of War:

The organization of the Chemical Warfare Service has been completed. Henceforth all phases of gas warfare will be under the control of the Chemical Warfare Service commanded by Major-General William L. Sibert.

Heretofore chemical warfare has been carried on by divisions in the Medical Department, the Ordnance Department, and the Bureau of Mines. All officers and men who have been connected with offensive or defensive gas warfare here will be responsible to the Chemical Warfare Service. The field training section at present in under the Corps of Engineers.

Defensive warfare has been under the control of the Medical Department. This work has consisted of the designing and manufacture of masks both for men and animals and the procurement of appliances for clearing trenches and dugouts of gas.

Offensive gas warfare consists principally of manufacturing gases and filling gas shells. The work has been under the direction of the Ordnance Department.

The new department will take over the work

of chemical research for new gases and protection against known gases which has been carried on by the Bureau of Mines. All testing and experiment stations will be under the direction of the Chemical Warfare Service.

The responsibility of providing chemists for all branches of the government and assisting in the procurement of chemists for industries essential to the success of the war and government has been intrusted to the Chemical Warfare Service.

All chemists now in the Army will be removed from their units and placed under the authority of the Chemical Warfare Service. Newly drafted chemists will be assigned to the Chemical Warfare Service.

Authority to assign enlisted men or commissioned chemists to establishments manufacturing for the government has been granted to the new section.

THE ORGANIZATION OF PHYSICIANS FOR WAR SERVICE

The Council of National Defense authorizes the following:

As the first step in a nation-wide campaign to enroll every doctor in the United States in the Medical Reserve Corps of the Army, the Naval Reserve Force, or the Volunteer Medical Service Corps members of the committees of the Medical Section, Council of National Defense, for the states of New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia and the District of Columbia met at the Hotel Washington in Washington. At this meeting the state representatives discussed with the representatives of the Council of National Defense details of the plan to be followed and received instructions.

This meeting is the first of a series, the United States having been divided into eight groups. The work will be subdivided among the state and county representatives of the Medical Section, Council of National Defense, in each state, and every doctor in the country who has so far not done so will be asked to apply for membership in the Medical Reserve Corps of the Army, Naval Reserve Force, or the Volunteer Medical Service Corps. Eligible to the Volunteer Medical Service Corps are all those who would be eligible to the Medical Reserve Corps were it not for being over the age of 55, physical disability, community or institutional need, or dependents. Women doctors are eligible to the Volunteer Medical Service Corps.

The states included in the various groups are as follows:

Group No. 1.—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

Group No. 2.—New York, Pennsylvania, New Jersey, Delaware, District of Columbia, Maryland, Virginia, West Virginia.

Group No. 3.—Michigan, Ohio, Kentucky, Indiana, Illinois, Wisconsin.

Group No. 4.—Louisiana, Tennessee, North Carolina, Georgia, South Carolina, Florida, Alabama, Mississippi.

Group No. 5.—Iowa, Minnesota, North Dakota, South Dakota, Nebraska, Montana, Wyoming.

Group No. 6.—Missouri, Arkansas, Kansas, Oklahoma, Texas, Colorado.

Group No. 7.—Washington, Oregon, Idaho.

Group No. 8.—Utah, Nevada, California, Arizona, New Mexico.

By authority of Surgeon-General Gorgas, of the Army; Surgeon-General Braisted, of the Navy; and Surgeon-General Blue, of the United States Public Health Service; Dr. Franklin Martin, chairman of the general medical board of the Council of National Defense, has appointed the following committee on classification of the medical profession of the United States for military and civil purposes. Colonel R. B. Miller, Marine Corps, United States Army; Colonel V. C. Vaughan, Marine Corps, National Army; Lieutenant-Colonel H. D. Arnold, Marine Corps National Army; Surgeon R. C. Ramsdell, United States Navy; Surgeon J. R. Phelps, United States Navy; Dr. Joseph Schoreschowsky, United States Public Health Service; Dr. Otto P. Geier, Dr. John D. McLean and Dr. C. E. Sawyer. Ex officio: Surgeon-General W. C. Gorgas, United States Army; Surgeon-General W. C. Braisted, United States Navy;

Surgeon-General Rupert Blue, United States Public Health Service; Lieutenant-Colonel F. F. Simpson and Dr. Franklin Martin.

This committee is authorized to meet at regular intervals and to cooperate with the committee on states activities, the state and county committees, and other agencies and societies engaged in advisory or executive functions dealing with classifications and enrollment for military, industrial and home needs.

THE STERLING BEQUEST TO YALE UNIVERSITY

THE residuary estate of John W. Sterling, which it is said will amount to $15,000,000, has been left by the terms of his will to Yale University. Mr. Sterling, who was of the law firm of Shearman & Sterling, died on July 5 while staying in Canada at the fishing lodge of Lord Mount Stephen. Of the remaining $5,000,000, $1,000,000 goes to the Miriam A. Osborn Memorial Home at Rye, N. Y., and $4,000,000 to relatives, friends, employees and charities. The clause which gives the residue of the estate to Yale University is this:

All the rest, residue and remainder of my estate not hereinbefore effectually disposed of, I direct my said trustees to dispose of in the manner following:

To apply the same, as soon after my decease as may be practicable, to the use and for the benefit of Yale University, in the erection in New Haven, Conn., upon land selected at its expense by it with the approval of my said trustees, of at least one enduring, useful and architecturally beautiful edifice, which will constitute a fitting memorial of my gratitude to and affection for my alma mater. The said trustees shall have entire liberty and discretion to apply any portion of the said property or its proceeds to the erection of a single building, and they shall apply the balance of said property, if any, to the erection and equipment of other fine and enduring buildings for the use of students in the academical or graduate departments, and, to some extent, to the foundation of scholarships, fellowships or lectureships, the endowment of new professorships, and the establishment of special funds for prizes.

In case I erect or provide during my lifetime for the erection of such a memorial edifice as is described in the first part of this article XXVIII., my trustees shall not be required to erect an additional memorial building, though they shall have complete power to apply my said residuary estate for the benefit of the said university to the erection of other edifices of a memorial character or to the other purposes specified in subdivision I. All buildings erected as aforesaid shall be made fireproof and shall be constructed in the most substantial manner.

Mr. Sterling was graduated from Yale in 1864. His bequest is the largest ever made to an American university, and the amount has only been exceeded by the gifts of Mr. Rockefeller to the University of Chicago and of Mr. and Mrs. Stanford to Stanford University.

MEMORIAL TO JOSIAH ROYCE

SOME of the personal friends and colleagues of Josiah Royce, who believe that his work and his character made a deep impression upon a wide circle of men and women, and that he became in fact the center of a large spiritual community, many of whose members were unknown to him, as he was unknown personally to them, feel that the reverence and affection which went out to him as a thinker and as a man should be embodied in some appropriate memorial of him at Harvard University, where he expressed himself in characteristic speech and writing for thirty years.

It is proposed, with this end in view, to create a fund of $20,000, to be known as the Josiah Royce Memorial Fund, the income of which shall go to Mrs. Royce during her lifetime, and thereafter to the department of philosophy of Harvard College, to be used in such ways as the department shall decide from year to year.

There are evident reasons why this appeal should not be delayed until the return of normal conditions, natural as such postponement might on some accounts appear to be. And further, the due honoring of our moral heroes, though a privilege under all circumstances is

especially a privilege and a duty in heroic times.

Those who desire to subscribe may send their checks to Charles Francis Adams, Esq., treasurer of Harvard College, 50 State Street, Boston.

Charles W. Eliot,
Charles P. Bowditch,
president, American Academy Arts and Sciences,
John Grier Hibben,
president, Princeton University,
R. F. Alfred Hoernle,
chairman, Department of Philosophy and Psychology, Harvard University,
Lawrence J. Henderson,
secretary, The Royce Club,
James J. Putnam, M.D.
E. E. Southard, M.D.
William Ernest Hocking

SCIENTIFIC NOTES AND NEWS

Professor A. A. Michelson, head of the department of physics, University of Chicago, has been commissioned as lieutenant-commander in the navy.

Dr. Richard C. Maclaurin, president of Massachusetts Institute of Technology, has accepted the appointment of director of college training, in charge of the Students' Army Training Corps under the War Department's Committee on Education and Special Training aiming to mobilize the higher institutions of learning.

Professor Julius Stieglitz, chairman of the department of chemistry at the University of Chicago, has been appointed as special expert in the United States Public Health Service of the Treasury Department. This will not involve his work at the university. The government assigns him two assistants, who will be in the employ of the Public Health Service and will carry out their work in Kent Chemical Laboratory under Professor Stieglitz's direction.

Major Anton J. Carlson, chairman of the department of physiology at the University of Chicago, who is now in the Sanitary Corps of the National Army attached to the Food Division of the Surgeon General's Office, is at present on duty in England, making a study of food conditions in the rest camps of the United States Army.

M. K. Akers, professor of applied electricity, at the State College of Washington, has been granted leave of absence for the duration of the war. He is now conducting research work in the development department of the Western Electric Company of New York. Harry L. Cole, instructor in chemistry at the State College of Washington, has been recommended for leave of absence during the period of the war, and is now training in the aviation camp at Berkeley, California.

The Royal Society of Arts has awarded the Albert Medal for 1918 to Sir Richard Tetley Glazebrook, C.B., Sc.D., F.R.S., "for his services in the application of science to the industries of peace and war, by his work as director of the National Physical Laboratory since 1899, and as chairman of the Advisory Committee for Aeronautics." The society's Albert medal, founded in 1863 to commemorate the presidency of Prince Albert, has been awarded annually "for distinguished merit in promoting arts, manufactures and commerce."

Oxford University has conferred the degree of master of arts *honoris causa* on John Louis Emil Dreyer, Copenhagen, late director of the Armagh Observatory.

The Birmingham medal of the British Institution of Gas Engineers, has been presented to Mr. John West, of Southport. Mr. West, who is eighty years of age, has been awarded the medal in connection with his work for the gas industry and Ministry of Munitions.

The David Livingstone Centenary medal of the American Geographical Society has been awarded to Colonel Candido Mariano da Silva Rondon in recognition of his valuable work of exploration in South America.

Mr. Herbert Samuel, M.P., has been elected president of the Royal Statistical Society of Great Britain.

PROFESSOR WILLIAM NORTH RICE, for the past fifty years professor of geology at Wesleyan University, is retiring from active work.

DR. S. J. BARNETT has resigned his post as professor of physics at the Ohio State University in order to accept the position of physicist-in-charge of experimental work at the department of terrestrial magnetism of the Carnegie Institution of Washington. He entered upon his new work at Washington, on July 15.

THE series of War Lectures given in July at the University of Chicago include the following: James Rowland Angell, head of the department of psychology, spoke on July 2, on "Psychology in the Service of the Army." On the same date J. Laurence Laughlin, professor emeritus of political economy, discussed "Economic War Lessons for the United States." On July 3 Professor Julius Stieglitz, chairman of the department of chemistry, discussed "Chemistry as a Factor in Modern Warfare." On July 5 Dean Rollin D. Salisbury, of the Ogden Graduate School of Science, presented "The Contributions of Geology to the War." On July 9 "Infectious Diseases and the War" was discussed by Edwin Oakes Jordan, chairman of the Department of hygiene and bacteriology.

THE faculty of the school of medicine of the University of Pittsburgh, have passed the following resolution in appreciation of Dr. R. E. Sheldon, who died on July 9:

Through the sudden death of Dr. Ralph Edward Sheldon, professor of anatomy, the school of medicine of the University of Pittsburgh has lost one of its efficient teachers, an indefatigable worker, and a man of resolution who has reaped abundant success. Dr. Sheldon's death has closed an active career, which was ascending to its acme in the mid-period of life. His work in the special field of neurology was gaining for him an eminent place with the leaders in this branch of research; his enthusiasm in building up his department was unbounded and his wide interest in the sphere of higher education was ever active. His colleagues deeply appreciated him in his work and as a loyal and trusted friend, and closely followed the growth of his successors. The medical faculty look forward to the publication of his book on neurology which will stand as the monument of his efforts.

Be it resolved that this appreciation of affection from his colleagues and associates be entered upon the minutes of this faculty meeting and the expression of their deep sorrow at his loss be extended to the members of his family.

DR. RICHARD RATHBUN, since 1897 assistant secretary of the Smithsonian Institution, and since 1899, in charge of the National Museum, died on July 16, aged sixty-six years.

PROFESSOR POZZI, a distinguished gynecologist and surgeon, on June 13, at the age of seventy-two years, was murdered in his consulting room by a lunatic patient, who thereupon committed suicide.

A CABLEGRAM was received on July 16 at the Harvard College Observatory from Professor B. Baillaud, director of the Paris Observatory, stating that Wolf's periodic comet was observed by Jonckheere, at Greenwich, in the following position:

July 9.508 G.M.T.
R.A. $20^h\ 35^m\ 13^s$
Dec. $+ 24°$

It was first reported by the Yerkes Observatory in California after an absence of seven years.

THE daily papers state that Professor Vincent read recently before the Paris Academy of Sciences a paper in which he described the preparation of a new serum which it is stated has proved effective even in desperate cases of gas gangrene.

A SPECIAL emergency act to give the government control over all platinum in the United States was recommended by members of the Ways and Means Committee of the House of Representatives on July 1, after hearing further evidence of the short supply of the metal. Chairman Kitchin told the committee he believed the measure should be enacted immediately instead of waiting for the enactment of the revenue bill, which may impose a heavy tax on all platinum users. Members of the committee agreed the situation was serious enough to warrant prompt action to provide a sufficient supply of the metal for war manufacture.

Sir Bernard Mallet, the Registrar-General of Great Britain, delivered a lecture recently at the Royal Institute of Public Health on "The effects of the war as shown in vital statistics." Dealing with the decline in the birth-rate due to the war, he said that in England and Wales the births registered in 1913 numbered 881,890. In 1915 they fell to 814,614. In 1916 there was a further fall to 780,520, the slightness of the fall from the previous year being due to the increase in marriages in 1915, when the number celebrated reached the "record" figure of 360,885. In 1917 the births registered fell to 668,346, a decline from the 1913 figure of 24 per cent. Up to the present there had been lost in England and Wales in potential lives, on the standard of 1913, 650,000. He thought that it would be long before the birth-rate reached the figure that obtained before the war. Serious as this loss is to the coming generations in Great Britain, he continued, there is reason to believe that it had suffered less in this direction than the other belligerent nations. In terms of percentages of loss on the pre-war population it may be assumed that Germany has lost in potential lives the equivalent of 4.5 per cent. of its total pre-war population, Austria 5 per cent., and Hungary 7 per cent. The statement may be hazarded that the present war, by the fall of births it has occasioned, cost the belligerent countries of Europe not less than 12½ millions of potential lives. While the war has filled the graves, it has emptied the cradles. At the present time, every day that the war continues means the loss of 7,000 potential lives to the United Kingdom, France, Italy and the Central Empires.

Technically trained men and women are needed for the examining corps of the Patent Office. Those are wanted who have a scientific education, particularly in higher mathematics, chemistry, physics and French or German, and who are not subject to the draft for military service. Engineering or teaching experience in addition to the above is valued. The entrance salary is $1,500. Examinations for the position of assistant examiner are held frequently by the Civil Service Commission at many points in the United States. One is announced for August 21 and 22, 1918. Details of the examination, places of holding the same, etc., may be had upon application to the Civil Service Commission, Washington, D. C., or to the Patent Office. Should the necessity therefore arise temporary appointments of qualified persons may be made pending their taking the Civil Service examination. Application for such appointment should be made to the Patent Office.

Opportunities in government work for women include the following, announced by the United States Civil Service Commission: *Bacteriologist:* Vacancies in Public Health Service, at $1,800 a year. Applicants must have graduated from a college or university of recognized standing in a course including biology and bacteriology and have had at least two years postgraduate experience in practical bacteriologic laboratory methods. *Biochemist:* The United States Civil Service Commission announces an open competitive examination for biochemist for both men and women for duty in Washington or elsewhere, at salaries ranging from $1,800 to $3,000 a year. Certification to fill the higher-salaried positions will be made from those attaining the highest average percentages in the examinations. Competitors will not be required to report at any place but will be rated on education and experience and publications or thesis to be filled with application.

There are still many elements of uncertainty in the search for oil pools, but some of these are reduced to a minimum in regions where rock outcrops are conspicuous and the relation of the oil pools to the structure of the rocks is relatively simple. These are the conditions in the Big Horn Basin, Wyo., a report on which has recently been published by the United States Geological Survey, Department of the Interior, as Bulletin 656, "Anticlines in the southern part of the Big Horn Basin, Wyo." The report is one of a series on the existing and prospective oil fields of the state, several of which have already been published.

Though oil was known to exist in the Big Horn Basin as early as 1888 and sporadic attempts have from time to time since been made to discover it in large quantities, the production of oil in this region may be said to have begun in 1906, when wells were drilled in the Byron field. Wells were afterwards drilled in several other parts of the basin, and though small quantities of oil and gas have been discovered in fourteen fields, the region is well known largely because of the production since 1914 from the Grass Creek, Elk Basin, Greybull and Torchlight fields. From 1914 to 1916 the production of oil in Wyoming rose from 3,560,375 to 6,234,137 barrels, and a considerable part of this increase has been derived from the fields just named. The report describes fifty anticlines and domes, twenty-seven of which have been tested by drilling. Four of these contain very productive oil and gas fields, and seven contain fields that are less productive and less promising. The anticlines lie in a broad belt around the border of the Big Horn Basin, and the authors of the report conclude that those which are nearest the central trough of the basin offer the greatest prospect for successful drilling. In fact, none of the explored anticlines that are separated from the central trough by other anticlines have yet yielded more than traces of oil and gas. As nine anticlines adjacent to the central trough remain untested there is a good prospect that other productive fields may yet be discovered. The report was prepared by D. F. Hewett and C. T. Lupton.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of Elmer P. Howe, of Marblehead, Mass., after private bequests amounting to between $35,000 and $40,000 are provided for, the residue of the estate is to be divided equally between Yale University and the Worcester Polytechnic Institute for general use. For the purposes of the probate bond the estate is estimated at $30,000 real and $400,000 personal property.

DR. CHARLES A. TUTTLE has presented to Yale University his home and offices, a large brick building on York Street, adjacent to Wrexham Hall.

ACCORDING to the Journal of the American Medical Association the number of students enrolled in the medical department of the University of Buenos Aires is over 5,000. In 1917, there were 4,078 enrolled, distributed as follows: medicine, 3,051; pharmacy, 317; doctor in pharmacy, 88; odontology, 428, and obstetrics, 194. Including the departments of law, engineering, philosophy and literature, agronomy and veterinary science, there are a total of 9,521 matriculated students. There are 984 students inscribed in the medical department of the other university in the country, the University of Cordoba.

DURING the absence of President Harry Pratt Judson, of the University of Chicago, as head of the American Commission for Relief in Persia, the dean of the faculties, Professor James R. Angell, head of the department of psychology, has been designated by the board of trustees as vice-president of the university.

FRANK L. DE BEUKELAER, professor of chemistry at Washburn College, Topeka, Kansas, has been appointed to an instructorship in the department of chemistry at the University of Chicago.

DR. CYRUS H. FISKE, who has held the position of assistant professor of biological chemistry at Western Reserve University, Cleveland, will join the Harvard medical staff with the same title.

DISCUSSION AND CORRESPONDENCE

THE SUPPLY OF ORGANIC REAGENTS

TO THE EDITOR OF SCIENCE: In order to provide for the supply of organic reagents for research and industrial purposes the Eastman Kodak Company has determined to commence their preparation in its research laboratory.

This decision was arrived at partly as a result of the letters of Dr. Roger Adams and Professor Gortner[1] which drew our attention to the need for an adequate supply of these materials produced by a firm of standing.

[1] SCIENCE, March 8, 1918, p. 226 and June 14, 1918, p. 590.

In order to carry on the work a separate section of the laboratory has been established under the title of the "Department of Synthetic Chemistry," which will be under the immediate direction of Dr. H. T. Clarke, well known for his publications on organic chemistry.

In order to meet the need expressed in Professor Gortner's letter and to make available to research laboratories in this country the organic chemicals which they require, it is proposed that chemicals for research work shall be supplied at the lowest possible price. At first, no doubt, this price will necessarily be higher than that charged by the German firms before the war, but it is hoped that eventually the profit made on chemicals supplied for commercial purposes may enable the rarer materials made in small quantities for research work to be sold at a price which will be within the reach of all who require them.

At first, of course, the laboratory will be able to supply only a limited number of substances, and these in small amounts, but the department will be expanded to meet the demand and with the assistance of other laboratories interested in organic chemistry, and of the firms who are producing dyes and intermediates, it is hoped that after a time an adequate supply of synthetic organic reagents can be made available.

It is possible that laboratories may have in stock unusual reagents which they are unlikely to require. If any laboratories possessing such reagents will write to us we shall be glad to make an offer for the materials, thus making them available on the market.

Our thanks are due to many of the chief chemists of the country who have encouraged us to commence this work and especially to Professor Roger Adams for the way in which he has received our proposals and has assisted us by placing at our disposal the information as to this work which he has accumulated.

Communications regarding reagents should be addressed to the Research Laboratory, Eastman Kodak Company, Rochester, N. Y.

C. E. K. Mees

July 11, 1918

FIREFLIES FLASHING IN UNISON

In Science for February 4, 1916, I published a short note entitled "Fireflies Flashing in Unison" in which I gave my own observations with confirmatory notes of K. G. Blair regarding a European species. This note led to a discussion in the pages of Science in which various views were expressed; one writer throwing doubt on the correctness of my observations, another suggesting that I was deceived and the effect psychological, another that it was the result of coincidence and still another giving confirmatory evidence of the phenomenon in question.

In Science for September 15, 1916, I was able through the courtesy of Professor E. B. Poulton of Oxford, to note the advanced pages of a book entitled, "A Naturalist in Borneo," by Mr. S. Shelford, an old student of Professor Poulton. Mr. Shelford describes vividly the synchronous flashing of fireflies he observed in Borneo. In Science for October 27, 1916, Mr. F. Alex. McDermott, who has made a special study of the light emission of American Lampyridæ,[1] has found no periodicity in the phenomenon. In Science for November 17, 1916, Mr. H. A. Allard says:

> The synchronal flashing of fireflies appears to be a very rare phenomenon in North America. So rarely does it seem to occur that one may consider himself fortunate if he has observed the phenomenon once in a lifetime.

His observations were made at Oxford, Mass. A heavy thunder storm had passed over followed by a profound calm, the air was very warm and humid; thousands of these insects were sailing low over the ground flashing incessantly as far as the eye could see. After a while a most remarkable synchronism in the flashing appeared to take place, giving one the impression of alternating waves of illumination and darkness in the distance. Though Mr. Allard had given great attention to the flashing of fireflies since these observations were made twelve years before he had never since observed this phenomenon.

In Science for September 28, 1917, Mr. Frank C. Gates, of Carthage College, from ex-

[1] *Canadian Entomologist*, Vols. 42, 43, 44.

periments made on two specimens in a tent with a flashlight and observations made in the Philippines concludes that the synchronism in the flashing of a group of fireflies is accidental and of very rare occurrence

Mr. Olaf O. Nylander, of Caribou, Me., to whom I sent a copy of my firefly article, in a letter dated October 8, 1916, says that a number of years ago, while walking from Caribou Mills to his home, he noticed in a small clearing the greatest assembly of fireflies that he had ever seen; the ground and stumps were fairly aglow. The flashes were not perhaps as regular as an army officer would like to see in regimental drills but were so rhythmic that any one would take note of their action. He also observed that the air was very damp at the time.

In *The Scientific American* of January 19, 1918, Mr. John V Purssell, of Washington, D. C., records that

> In the town of Cotabato, Island of Mindanao, P. I., a few years ago, there were two trees about the size of apple trees, and perhaps a hundred feet apart, and every evening these were filled with fireflies which flashed in synchronism, first one tree lighting up and then the other. There must have been several thousand insects in each tree, yet the synchronism was so perfect that rarely or never did a single firefly flash at the wrong time.
>
> To the best of my recollection the illuminated period lasted about two or three seconds and the dark period perhaps twice that long. I can positively vouch for the accuracy of the foregoing for it seemed so strange, and produced so beautiful an effect that I thought it one of the most remarkable things in the Philippines, and it made a deep impression on me.

The independent observations of this synchronism in the flashing of fireflies by the author in Gorham, Me.; K. G. Blair in Europe; S. Shelford in Borneo; Dr. H. C. Bumpus near Woods Hole, Mass.; H. A. Allard in Oxford, Mass.; Olaf O. Nylander in northern Maine and John C. Purssell in Mindanao, Philippine Islands, are I think quite sufficient to establish the fact that these insects do at times flash in unison. The rarity of the occurrence is a mystery.

In this connection a coincidence might explain a well-known occurrence in a small group of individuals, as at a dinner party when they all cease talking for an appreciable time, but would not explain the quiet pause which one sometimes observes in a large dining hall containing hundreds of diners. I discovered the cause of this phenomenon some years ago. While dining with a number of friends at the Parker House the guests at a neighboring table had been noisy, even boisterous, doubtless we had been somewhat noisy too. The neighboring table suddenly became quiet and we stopped talking to see if the noisy ones had gone, but they were still there, other tables looked about for the pause and this hush spread rapidly through the hall. Dear old Dr. Virchow had often observed this pause and thought my explanation correct. He also told me that it was a saying in his country that when this hush occurred an angel was passing through the room, also that a lieutenant was paying his debts! So in regard to fireflies a dozen or more might flash for awhile in unison as a coincidence, but when thousands are observed to flash in unison no doctrine of probability or chance can account for it.

EDWARD S. MORSE

SALEM, MASS.,
July 2, 1918

THE VERO MAN AND THE SABRE TOOTH

IN determining the relative antiquity of the Vero man and the fossil plants and animals there associated, certain larger factors yet require attention. The direct evidence has been minutely examined from varying points of view: geologic, paleontologic, anthropologic. It seems conclusive that the man of Vero reached one of the last lairs of the sabre-toothed tiger, as Dr. Hay contends; while Berry discloses a degree of change in the local flora not to be ignored. But, on the other hand, the anthropologists show that the accompanying artifacts are like those elsewhere recent.

Perhaps the anthropologists have the best of the *argument,* as such. Florida has retained much its present outline since the close

of the Eocene, sometimes a little below the ocean level, never far above. Geologic change has been at no time great enough to prevent the easy reentrance of the sub-tropic vegetation, persistent in the United States at three points only—the Lower Colorado, the Lower Rio Grande, and the lower part of the "spruce pine," and *Pinus heterophylla* sections of Florida. In each of these widely separated regions larger continental features tend to create and maintain melior climatic conditions. The Colorado cuts deep, and holds its valley protected from the cold. The gulf warms the low coastal strip markedly as far north as the mouth of the Rio Grande; and Florida, though flung well out to sea, so blocks the warmer gulf waters that the southern half has long held to the favorable mean of dry days, rain and warmth. Long coastal barriers afford further protection.

Even a cursory glance at forest distribution in Florida serves to throw into relief the belts and regions of change of first concern. The upper half of Florida is still favorable to the "long leaf pine" (*Pinus palustris*), and now undergoes marked variation in its winter temperatures. Facing the Atlantic, this forest sharply gives way to the "spruce pine," and not far below Vero the palmetto-cycad underbush begins. Along the southern-western coast, is the region of "pine islands and cypress straits," as Bowman says, "even more monotonous than the east coast." All the higher ground is invested by a *Pinus heterophylla* forest, with a nearly pure palmetto underbush, while the cycads also show a different facies. The *Zamia floridana* is rare in the open woods, although the *Z. pumila* grows more characteristically inside the mangrove fringes next the coast.

The Vero man thus occurs near the border of the "spruce pine" (*Pinus glabra*) forest, with its striking and unique underbush of cycads and bush palmetto (*Zamia floridana* and *Sabal serrulata*). The latter in places make up the underbush nearly in equal numbers. But that this striking forest facies earlier extended to the north of Vero is probable; while in any case Vero lies within a region locally characteristic for its old floral elements, and of generally soft climate since the Eocene.

Evidently the "spruce pine" country exemplifies a pronounced type of the so-called "asylum" or isolated and persisting habitat subjected throughout long periods of time to the minimum of environmental change. Especially the cats earlier tended to drift to the south; and there the man of Vero found them when he reached that soft climate and employed or developed arts admittedly recent. Seemingly too, the fossil plants and animals of Vero, after persisting beyond their geologically appointed time, were finally cut off by changes relatively slight.

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SCIENTIFIC BOOKS

Fossil Plants. By A. C. Seward. Cambridge Biological Series 1917. Vol. III., pp. xviii + 656, 629 figs.

The present volume, the third of Seward's great work, Volume 1 having been published in 1898 and Volume 2 in 1910, is appropriately dedicated to the late Professor Zeiller, the dean of paleobotanists. It is to be followed by a fourth volume, which it is stated is already in press, and which will discuss the remaining gymnosperms—the great group of angiosperms, so abundant in the fossil record from the mid-Cretaceous to the present, apparently not coming within the category of fossil plants in the mind of a British botanist, which is quite in keeping with British tradition and practise.

Volume 3 opens with a very satisfactory chapter devoted to a discussion of existing cycads, largely an abstract of already published data. Then follow three chapters devoted to the Pteridospermæ. These are divided into three families—the Lyginopteridæ, Medulloseæ and Steloxyleæ, and are rather fully and very satisfactorily discussed.

The remaining structural forms that are probably more or less closely related to the foregoing pteridospsrms are considered to represent the following seven families: Megaloxyleæ, Rhetinangieæ, Stenomyeleæ, Cyca-

doxyleæ, Calamopityeæ, Cladoxyleæ and Protopityeæ, and these are discussed in a separate chapter under the group term of Cycadofilices. These presumable pteridosperms, because of the dearth of conclusive evidence, are thus arbitrarily segregated. While caution is to be commended in dealing with fragmentary plant fossils it may be questioned whether judgment may not be suspended until it dies of inanition. It is also questionable how far it is desirable to introduce purely artificial groups, and if it be granted as desirable, it may be pertinent to ask what criteria are to decide such a question. That such a course does not make for clearness and that such questions rest after all upon personal equation rather than upon objective facts may be illustrated by Seward's reference of the genus *Steloxylon* to his Pteridospermæ and the scarcely to be distinguished genus *Cladoxylon* to his Cycadofilices. The fact that so many of the so-called families of the latter group are monotypic is convincing enough evidence that they illustrate chance discoveries and the imperfection of the geological record and that they have absolutely no other significance such as Scott has suggested.

Following the chapter devoted to Cycadofilices are two chapters dealing with the Cordaitales which are described under the three groups of Poroxyleæ, Cordaiteæ and Pityeæ. A succeeding chapter of 65 pages is devoted to Paleozoic gymnospermous seeds and the remainder of the book is taken up with a consideration of fossil Cycadophytes. These last chapters are, on the whole, a very satisfactory summary of the present state of our knowledge although the concluding chapter, devoted to the fronds, is much abbreviated and not especially noteworthy.

There can be no doubt of the usefulness of Seward's book, particularly in the case of mature students and professional morphologists. The author has a wide acquaintance with the literature, especially on the side of morphology and modern botany, and the book shows throughout the results of considerable original work and a large amount of reinvestigation of insufficiently described material of older workers. It may seem ungracious to criticize a noteworthy undertaking but it seems to the reviewer that throughout the three volumes already published there is a disregard of proportion and an unevenness of execution that seriously impair their value. It is impossible to discover the method of selection of matter to be included—unimportant and even doubtful forms are sometimes discussed, as under *Williamsonia,* among the seeds, or the frond genera of Cycadophytes, while more important material is not even mentioned. In a work spreading through four stout volumes one reasonably expects either completeness or a formulated method of selection. If the desire was to present in the main fossil plants based upon structural materials, why burden the pages with a very incomplete representation of other classes of plant remains.

The author assumes an oracular air that reminds one of Lowell's charming essay entitled "On a certain condescension in foreigners," and there is constantly displayed a readiness to pass judgment merely on the illustrations of other students' work, often in cases where most paleobotanists would be disposed to deny the author's competency, as for example in the case of the determination of American species referred to *Eremopteris.* There are also certain insular tendencies, as in the overemphasis of Carboniferous, Jurassic and Cretaceous horizons that have been studied in Britain, and the space devoted to the local history of important British specimens.

Professor Seward's position on the difficulty of founding well-marked botanical species on material preserved as impressions is well known and in the main sound. However, as has been pointed out recently by Halle, this does not justify the assumption that all fossils that are superficially similar belong to the same species regardless of geographical position or geological horizon. Such a method of treatment entirely obscures whatever real value such fossils may have for purposes of deduction concerning geographical distribution, the problems of paleogeography growing out of distribution, and the bearing of fossil plants upon stratigraphy.

As a contribution to morphological botany nothing approaching the present book from the paleontological side has ever been produced and I am not surprised that Scott[1] is enthusiastic about it. I would expect Professor Coulter to be equally enthusiastic. As a textbook of fossil plants intended for geological students as its subtitle indicates, or as an exposition of the geological history of fossil plants it is very inadequate, and I regard this as a serious defect since the great majority of students who will use the book, while they will gain a much wider morphological outlook, will scarcely learn that fossil plants have attributes other than anatomical, or if they do they will conclude that such attributes are worthless anyway. Nor will they gather the impression that fossil plants are found much anywhere except in the Carboniferous, Jurassic and Wealden.

The proofreading of volume 3 is not as good as in the preceding volumes and some of the illustrations are very poor; nor is the bibliography as complete as it might well have been made. A paper by White is credited to Knowlton, Vignier should be Viguier. Krammera (page 277 and elsewhere) should be Krannera. The statement on page 276 that there is no proof of Cordaites in the Arctic may be a statement of opinion—it is hardly a fact. The statement on page 276 that "it is by no means certain that Cordaites flourished before the Carboniferous" is also misleading. Apparently Seward wishes to restrict the Cordaitales in their earlier manifestations and extend them in their later manifestations as in the case of *Noeggerathiopsis* and similar remains. Surely *Callixylon Oweni* described by Elkins & Wieland from the Devonian of Indiana[2] is ample evidence for the presence of Cordaites in pre-Carboniferous rocks. It may be seriously doubted if the two types represented by *Cycadeoidea* and *Williamsonia* were not much more divergent than is indicated, or if the former were the Mesozoic lords of creation of the vegetable world that is assumed. Despite the similarities in the fructifications in these two lines, the reviewer would regard the former as a specialized sideline without issue and probably never more abundant or important than are cycads in the existing flora, while the latter constituted a more dominant and progressive line, more intimately connected with the Paleozoic pteridosperms and having points of contact with possibly the Ginkgoales or the Coniferophytes. The bulk of the frond genera were probably borne by plants of the *Williamsonia* rather than of the *Cycadeoidea* type. It may be noted that the American Cycadellas come from the Lower Cretaceous and not the Jurassic. The author is hardly justified in doubting the bisexual character of the so-called flowers of *Cycadeoidea Gibsoniana*, nor is it easy to follow him in his explanation of the corona of *Williamsonia gigas* as morphologically a whorl of connate stamens in a central terminal position.

When it is remembered that throughout all of the *Cycadeoidea* species already investigated the megasporophylls become more or less sterile distad and that in some species, as Wieland has demonstrated, these, together with the prolonged interseminal scales, are modified to form a mop-like tuft at the apex of the receptacle, and also having in mind the ears or wings of the microsporophylls that formed a canopy over the apex of the receptacle in *Cycadeoidea colossalis*, it is quite possible to explain Seward's figures 546 and 547 in a variety of ways without recourse to the improbable hypothesis that we have terminal microsporophylls. In fact, there is no evidence that the so-called microsporophylls of *Williamsonia gigas* described on page 435 belong to that species. Fig. 549 no doubt represents a synangia-bearing disk of a *Williamsonia*, but there is not the slightest evidence that it belonged to *Williamsonia gigas* or that it should be placed on the end of a *Williamsonia* carpellary receptacle. Similarly the sterile disks or infundibuliform organs have not been demonstrated to have been borne on the apex of the receptacle.

On page 89 some poorly preserved *Myeloxylon*

[1] Scott, D. H., *New Phytologist*, Vol. 16, Nos. 8, 9, 1917.

[2] Elkins, M. G., and Wieland, G. R., *Am. Jour. Sci.* (IV.), Vol. 38, pp. 65–78, 1914.

petioles are appealed to as evidence of the existence of *Medullosa* in North America. Of course fronds are not evidence so it may be reassuring to state that characteristic sections of petrified stem material of *Medullosa* are contained in the collections of the U. S. National Museum, so that it may now be considered proven that *Medullosa* foliage was, in life, borne on *Medullosa* stems in America as well as in Europe. It may be questioned (page 87) whether leaf form is more protean than either vascular anatomy or floral morphology. Apropos of Seward's remarks on the genus *Schützia* it may be noted that in a paper which has apparently been overlooked, Schuster[3] describes specimens of *Schützia anomala* in the Dresden Museum, labelled in Geinitz's handwriting, which show definitely that these objects were spore receptacles as had been surmised.

The forms known as *Microzania gibba* (page 504) and *Zamites bohemicus* (page 534) come from the Upper and not the Lower Cretaceous. It would be far better if the term Wealden were used to denote a peculiar environmental facies as shown in the lithology and not a chronological unit. There is no more reason for calling deposits in all parts of the world Wealden than there would be for calling the English Wealden deposits Potomac.

On page 278 the genus *Pelourdea* is proposed for the long-known *Yuccites vogesiacus* of Schimper & Mougeot because the author considers it undesirable to retain a designation suggesting false ideas with regard to affinity. No one now supposes that this is suggested and such a proposal is entirely unwarranted and can only be confusing instead of clarifying. Moreover it is flying in the face of all canons of nomenclature. A name of a genus is simply a name, and we use generic names for convenience chiefly, and not in a descriptive or phylogenetic sense. I imagine that fully 25 per cent. of the names in systematic botany and zoology are equally inappropriate for one reason or another but this does not afford any justification for attempting to replace them. There is surely a difference between retaining a degree of personal independence in the face of codes and the persistent refusal to recognize the fact that practises of this sort serve only to confuse the subject.

Cordaianthus Pitcairnæ figured on page 266 is merely a type of inflorescence and is scarcely entitled to a specific name. At *B* in the same figure (Fig. 480) there is figured from the Kidston collection, a specimen which is called *Cordaianthus Volkmanni.* The latter belongs to the type of inflorescence which Grand'Eury called the *gemmifer* group, to which this specimen does not belong, although it does belong to Grand'Eury's *baccifer* group, and should probably be identified as *Cordaianthus subvolkmanni.* The genus *Holcospermum* (page 361) is hardly an improvement on *Carpolithus,* and it would seem that if form genera for seeds are worth anything at all then *Holcospermum* should be referred to Zalessky's genus *Polygonocarpus.* This last genus is mentioned under *Polypterospermum* on page 323 where we are told that *Radiospermum* or *Polypterospermum ornatum* should probably be referred to it, while on page 358 we are told that this species affords another example of *Polypterocarpus* as this generic name is employed by the author. Nowhere is the genus *Polygonocarpus* discussed (it is not even in the index) although it is of some importance, and, if one may judge from Scott's figures of *Trigonocarpus Parkinsoni,* is the proper name for his specimens of the latter. If the reader will turn to Seward's Fig. 426 *C* he will see that the sclerotesta of Scott's *Trigonocarpus Parkinsoni* is of exactly the type of *Polygonocarpus.* Now if this figure be compared with Fig. 425 on the opposite page, also called *Trigonocarpus Parkinsoni,* it must be apparent that the two do not represent the same seed or the many angles of the former would show through the partially preserved sarcotesta of the latter, which is not the case, nor is it desirable on general principles to refer structural material to form genera based upon casts.

[3] Schuster, J., "Uber die Fruktifikation von *Schuetzia anomala,*" *Sitz. k. Akad. Wiss. Wien,* Band 120, Heft 8, Ab. 1, pp. 1125–1134, Pls. 1, 2, 1911.

As an instance typical of that unevenness of treatment previously mentioned the genus *Samaropsis* may be examined with some slight detail. In Fig. 502 *A* on page 350 are shown three figures copied from Dawson of *Samaropsis fluitans*. This species is apparently selected for discussion and illustration since this name appears in many lists of Carboniferous fossils from various localities. Dawson's figures are notoriously unreliable, as is very well known on this side of the Atlantic, and his types of *Samaropsis fluitans* scarcely deserve to be taken up as the types of anything. Now if we turn to *Samaropsis fluitans* as identified by Weiss we find that it represents an altogether different object. Similarly Kidston's and Zeiller's *Samaropsis fluitans*, while they are identical with one another, can hardly be considered as identical with either Dawson's or Weiss's objects so named and Grand'Eury's *Samaropsis fluitans* is a still different object. Turning to the second species shown in this figure, namely *Samaropsis emarginatum* of Goeppert & Berger, we find that the type figures are absolutely unrecognizable. We find that Geinitz referred two totally different forms to this species, Hoffman & Ryba's determination of it is questionable, Feistmantel's forms of this name are still different, and Kidston's figures of 1902, 1908 and the present work can scarcely be regarded in any single instance as representing any of the previous determinations. If we turn now to *C* and *D* of this same figure, supposed to represent *Cordaicarpus Cordai* of Geinitz we find that Geinitz figured a variety of things under this name, but he expressly states in his text that these seeds are 2 cm. in diameter and sometimes twice that size and tumid. When we turn to Zeiller's, Kidston's or Vernon's figures called by this name we find a tiny, often flat, form, totally unlike anything that Geinitz figured. It may also be suggested that *E* of this figure is upside down and that instead of having a *Samaropsis bicaudata* we have a *Samaropsis bicornuta*, for which there are analogies in other species of *Samaropsis*.

These instances may be taken to illustrate my criticism that unsatisfactory forms were selected for figuring in the present work without any digestion of the subject simply because the names occur frequently in the literature, a method of procedure which not only entirely obscures any chronologic value that these objects might have, but crowds out figures or discussion of really good material. The case may be stated something as follows: The poorer the type material of a species the more readily will other things be confused with it and so in the course of time it is always the least recognizable and the poorest types that become credited with the greatest range, both geological and geographical.

This sort of criticism might be legitimately applied to many other items in the present volume. These are almost always subjects outside of Professor Seward's own specialty, and subjects in which I fancy he is not greatly interested, and while they do not detract from the value or accuracy of that part of the work where the author is on familiar ground, an author should not pose as an authority on phases of work in which he shows no apparent interest or willingness to give the labor necessary to the mastery of the literature, so much of which it is admitted is of minor value.

For this very reason and the further reason previously mentioned of Seward's attitude regarding what constitutes a fossil species, it may be considered very fortunate that the author has been unable as yet to carry out his intention of discussing the geographical and geological distribution of fossil plants.

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SPECIAL ARTICLES

THE GLASS SANDS OF PENNSYLVANIA

At present in the manufacture of glass, nearly pure quartz sands are used almost exclusively as the source of the silica which is the major constituent of all the common varieties of this useful substance. An ideal glass sand would be one made up entirely of grains of the mineral quartz. Sands containing 100 per cent. silica, however, are not found in nature, although some very nearly approach

this composition. When a complete chemical analysis of a glass sand is made, minute amounts of alumina, ferric and ferrous oxides, magnesia, lime, titanium oxide, traces of the alkalies, and varying amounts of water are usually found to be present. Some of these constituents are harmless, while others have a very deleterious effect upon the glass.

Alumina imparts both desirable and undesirable properties to the resulting glass. It reduces the tendency of the glass to devitrify or crystallize. It decreases the solubility of the glass in water, weak acids, and other reagents, which is very desirable in the case of bottles and chemical glassware. It increases the surface tension of the glass when chilled rapidly, which is beneficial in molding, as the glass will not take on the minor imperfections of the mold, while, on the other hand, it will still be sufficiently viscous to assume the general shape of the mold. It reduces the coefficient of expansion of the glass and increases its tenacity, a feature also desirable in the case of bottles and chemical glassware. Alumina in glass facilitates annealing. It also makes the glass somewhat harder and a little more brilliant. An undesirable feature is that alumina tends to decrease the fusibility of the glass and increases its viscosity. It should, therefore, not be present in amounts exceeding 3 per cent. Also glass cullet containing alumina does not mix well with other glass and, therefore, tends to produce cords or striæ when used. The light blue tint noticeable in certain glasses made from salt cake is thought by some observers to be due to alumina in the form of a compound analogous to ultramarine blue. Alumina may occur in glass sands in the form of kaolinite, mica, feldspar, or hornblende. If it is present as kaolinite or mica it may be largely removed by washing.

Iron in the form of either ferric or ferrous oxides is the most detrimental impurity found in glass sands on account of its coloring effect upon the glass. Ferrous iron imparts a bluish green tint upon glass, while ferric iron produces a yellow tint, which is not nearly so noticeable. Since most glass is made under reducing conditions, the green color is the one usually developed. Where the amount of iron present is small, this coloring effect can be in part overcome by the use of manganese dioxide, nickel oxide or selenium. For the best grades of optical glass the percentage of ferric oxide present in the sand should not exceed .002 per cent. For the better grades of lead flint used in the manufacture of cut glassware it should not exceed .02 per cent. In the case of plate glass to be used for mirrors the ferric oxide should not be over .1 per cent., while in the case of plate glass to be used by transmitted light it may run up to .2 per cent. For window glass the amount may be as high as .5 per cent., while in the case of ordinary green and brown bottles sands containing from .5 to as high as 7.0 per cent. ferric oxide is used. Iron may be present in the sand in the form of limonite, hematite, magnetite, ilmenite, biotite, hornblende, or chlorite. A little may also be introduced as metallic iron from the machinery used in crushing the sandstone to sand. If it is present as limonite or hematite closely associated with the kaolinite or clay, it may be in large part removed by washing. If, on the other hand, the limonite or hematite adheres closely to the quartz grains washing will be of no avail. The other minerals mentioned can not be readily removed by washing.

The small amounts of magnesia and lime occasionally present in glass sands have no detrimental effect upon the glass. All the common varieties such as plate, window, and bottle glass contain lime as an essential constituent. Magnesia is much more apt to be introduced into the glass batch through the limestone used than through the sand. The composition of this material, therefore, must be watched with respect to this constituent. Alkalies, likewise, enter into the composition of glass and the minute traces occasionally present in the sand, therefore, are not harmful. Titanium oxide never occurs in sufficient amounts to have any detrimental effects upon the glass. It usually occurs in the sand as minute hairlike inclusions of rutile in the quartz grains, themselves. In the case of the better grades of glass such as optical, lead

flint, and plate, the sand is always carefully dried before being used.

In size for ordinary purposes of glass manufacture practically all of the sand grains should pass through a 30-mesh sieve, or in other words have a diameter less than .64 millimeters. The majority of the grains should be retained on a 120-mesh screen, or be over .136 millimeters in diameter. For optical glass, all of the sand should pass through a 48-mesh sieve. The shape of the grains has little to do with the relative values of the sand, although perhaps an angular sand is a little more desirable than one in which all of the grains are well rounded, other factors being equal.

In 1915, Pennsylvania produced 455,112 tons of glass sand. This represents about one fourth of the total production of glass sand in the United States. Pennsylvania holds this important rank as a producer of glass sand for two reasons: first there are found within her borders an abundant supply of nearly pure quartz sandstones that yield when crushed an excellent grade of sand, and secondly the center of the glass industry of the United States is located in western Pennsylvania so that there is a great demand for such sand. Nearly all of the glass sand at present produced in Pennsylvania comes from two formations, the Oriskany of the Devonian and the Pottsville of the lower Pennsylvanian. Of these the Oriskany is by far the more important.

The Oriskany formation occupies the belt of Appalachian folding which crosses Central Pennsylvania and which reaches a maximum width of nearly 56 miles. It varies greatly in this area both in thickness and in character. In Huntingdon and Mifflin counties a pure quartz sandstone phase, which has a thickness of from 60 to 200 feet, is particularly well developed. In its unaltered state it is a hard bluish-gray quartzite made up of interlocking grains of quartz in which silica in parallel orientation with the original grains is the bond. Under favorable conditions of weathering this has become disintegrated to a friable sandstone, or in some places even to a loose sand. These are the portions that are used for glass sand. For this purpose the sandstone must be sufficiently friable so that small pieces may be broken up between the fingers into loose sand. In preparing it for the market the rock is passed through a jaw crusher and chaser mill or wet grinding pan to disintegrate it into loose sand. It is then screened, passed through a screw conveyor type of washer, the excess water is allowed to drain off, and the sand is dried in a steam or direct heat dryer. After a final screening it is ready for the market. Much of the best grade of glass sand produced in the United States comes from this district.

The Pottsville formation of western Pennsylvania is divided into five members as follows, commencing at the top: the Homewood sandstone, the Mercer shale, the Connoquenessing sandstone, the Sharon shale, and the Sharon or Olean conglomerate. Of these portions of the Homewood and the Connoquenessing sandstones are at times sufficiently pure quartz sandstones to be available for glass sand. The sand derived from them, however, is never as pure as that from the Oriskany of central Pennsylvania and is, therefore, used only in the manufacture of the cheaper grades of glass such as bottle and window glass. A little is also used in the plate-glass industry. The method of treatment is usually the same as that used on the Oriskany sandstone in central Pennsylvania, except that drying is usually dispensed with. Sometimes, however, the rock is simply crushed dry and screened, washing not being resorted to.

Chas. R. Fettke

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